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BY

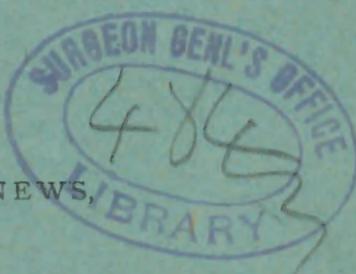
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INSTRUCTOR IN HYGIENE AND CLINICAL MICROSCOPY IN JEFFERSON MEDICAL COLLEGE; BACTERIOLOGIST TO ST. AGNES'S HOSPITAL.

FROM

THE MEDICAL NEWS,

January 7, 1893.



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THE question as to the disposal of human excrement has agitated the mind of man from time immemorial. The earliest authenticated record we have of laws regulating the disposal of excreta is in the injunction laid upon the Israelites to so fashion their spears that they might dig holes in the earth and therein bury their dejecta. The Israelites being at this time a nomadic people, and the country but sparsely settled, such a method was without serious objections. With the establishment of permanent camps and cities, however, the people were compelled to devise other means.

In the earlier ages, and also at the present time in remote places, privies built on the ground-level over shallow holes or barrels, etc., sunk in the ground were deemed sufficient. These muck-heaps were often situated in close proximity to dwellings and the sources of water-supply. The solid portion was seldom removed, but accumulated, and formed a vast pest-heap, which, when it was decided to clear it away, was quickly disposed of in the most convenient water-course, though occasionally it was used for fertilization. The liquid portion, contain-



ing noxious organic and inorganic substances in solution, percolated through the soil, polluting the source of water-supply and vitiating the air passing through the ground into the house. With the enlightenment of the people and renunciation of the abject servility imposed by political demagogues and hierarchies, science, deprived of right and destitute of prerogatives, was importuned to relieve the nation of its stink, to check and annihilate the filth-diseases rampant throughout the civilized world. Sanitary science, thus fostered and encouraged, responded nobly and has now discovered processes whereby sewage may be purified and utilized without seriously jeopardizing public health.

In this article only the discussion of the most important methods will be taken up. These include (1) the precipitating process; (2) the filtration process, and (3) irrigation.

The objective point in precipitating processes is the separation of the solid constituents from the liquid portion and rendering the effluent pure, or at least innocuous.

Two methods are practised to attain this result: (1) By simple subsidence, and (2) precipitation with chemicals.

By the first procedure the sewage is directed through wire screens into tanks provided with overflow tubes. The sewage remains in the tank for a time sufficient to separate the fluid from the solids. The effluent is drawn off through the overflow tubes and the sludge removed and burned or sold for fertilization. The liquid is allowed to flow into the most convenient water-course. As chemical anal-

ysis has demonstrated that this liquid is but little improved by subsidence, this process has been given up for a more efficient one: The effluent is passed through perforated drains from one to one and a half feet under the ground-surface and allowed to escape into the subsoil. This method is, however, applicable only for single houses and small communities.

Precipitation by chemical agents. By the admixture of certain chemicals the suspended and a considerable amount of the dissolved matter is precipitated. The sewage should be treated while in a fresh condition and the chemicals added before it is discharged into the receiving tanks or reservoir. These tanks are arranged in duplicate series, their number depending upon the amount of sewage to be treated.

The chemicals from which the best results have been obtained are lime, aluminium sulphate, and ferric sulphate, used separately or in combination. After precipitation, although the effluent is clarified, it is not innocuous, and to complete the purification it is expedient to combine the filtration with the precipitating process.

The filtration processes are effected by straining the sewage through substances having the faculty of arresting the solids and purifying the effluent. In some instances the sewage is simply strained through gravel or coarse sand. By this method the suspended particles are arrested, but the effluent is not purified. Carbon has been employed, but has proved unsatisfactory. Of all filtration processes, intermittent downward filtration through earth

most completely purifies sewage. The degree of efficiency depends upon (1) the porosity of the soil, (2) the fall of the land. There should be one cubic yard for each eight gallons delivered in twenty-four hours. It is computed that one acre of ground will take up 100,000 gallons of sewage in twenty-four hours. To further facilitate the filtration of sewage, it should be delivered in pipes at least six feet under the surface. The filtration surface should be divided into four sections, and no one section should receive sewage for more than six consecutive hours. The surface of the plot should be ploughed in ridges on which vegetables are grown.

In England, irrigation, combined with either filtration or precipitation, has been pronounced the most efficient and profitable process for the utilization of sewage. The ground selected for the farm should be porous, light loamy soil. The farms are arranged in ridges along the tops of which run trenches carrying the sewage. The sewage is discharged at regular intervals, through series of sluice-ways, into furrows. On the ridges are grown Italian rye, grass, peas, maize, cabbages, cereals, etc. The suspended organic matters are arrested in the soil and oxidized or resolved into harmless compounds by the organisms there present. The dissolved organic substances furnish pabulum for the growing vegetation.

This country, with its cities environed by extensive agricultural districts, affords the most happy and natural facilities for the employment of sewage.

A modification of the foregoing process might be adopted with profit to a municipality and the

advantage of enriched lands and augmented crops to the agriculturist.

The sewage of the city of Philadelphia is disposed of in two ways: (1) By the sewers emptying into the Delaware and Schuylkill Rivers, and (2) by being conveyed to the "Neck,"¹ where it is discharged upon the lowlands.

By the first process, our rivers (the sources of the city's water-supply) receive directly and undiluted the pestilential sewage of the city and the noisome refuse of the manufactories situated along their banks.

The rivers are thus practically converted into immense sewers, and the peculiar, delectable flavor of this mixture has conferred upon Philadelphia a most invidious distinction.

In the second method, the sewage is conveyed to the dumping-grounds in tank wagons, where it is transferred to sprinklers and promiscuously distributed in the furrows, over the vegetables, here, there and everywhere. The dumping-grounds ultimately become the most foul and noisome marshes conceivable. Not satisfied with begriming Nature's sweet face with the filthiest of filth, these philanthropic individuals turn their cattle into these muck-fields to pasture.

Though the effects of this latter method are not so widespread, its baneful influences are terribly obvious in the southern section of the city, and particularly in the southeastern section; for it is here that the milkman of the "Neck" carries a pail

¹ The territory in the county of Philadelphia lying between the Delaware and Schuylkill Rivers and south of Snyder avenue.

in one hand from which he dispenses elaborated garbage (so-called milk), tinctured with sewage, and in the other a bucket in which he collects the crude article. Is it surprising, then, that this method should be considered not less objectionable than the first?

The pail system adopted by Rochdale, Nottingham, Halifax, Manchester, Leeds, and Birmingham, deserves passing notice. The "by-laws" require (1) specially constructed closets, and (2) suitable pails.

The floor of the closet, made of some impermeable material, is raised several inches above the ground-level, with a slope of one-half inch to the foot toward the door. It is well ventilated by a six-inch shaft extending from beneath the seat to above the roof. The seats are hinged in order that the pails may be readily removed. The pails are made of wood and coated with creasote, or tar and galvanized iron. They should be round, with flanged tops and have a capacity not exceeding eight cubic feet. An airtight-fitting lid is provided to prevent nuisance in removal. In use they are placed in juxtaposition with the seat. Some of the cities mentioned have a second pail for the reception of ashes, house-refuse, etc.

Feces, having been discharged into the pail, are sprinkled over with finely sifted ashes or soil, which act as deodorants.

Where the pail system is in operation the sewage is burned in furnaces, or by the addition of finely sifted ashes and lime converted into fertilizing material.

We think it not inopportune to conclude by men-

tioning the method adopted in London. The sewage is conducted by the main sewers to Barking and Crossness. Large works have been completed at Barking, and similar works are in process of construction at Crossness, for separating the grosser element. Before the sewage enters the works it is strained through iron cages which retain the larger bodies. This, amounting in one week to seventy tons, is incinerated in a Hoffman furnace. The liquid, having in suspension the finer particles and a considerable quantity of dissolved organic matter, is directed into large tanks for subsidence, which is facilitated by the addition of lime, thirty-seven grains, and iron sulphate, fourteen grains, to each gallon of sewage. In this manner twenty thousand tons are precipitated in one week. The sludge is forced by powerful pumps into tanks on board ships expressly constructed for the purpose. The ships, having a capacity of one thousand tons, convey the sludge to sea, where it is discharged. The effluent, containing but two grains of solid per gallon, disembogues into the Thames.

The abandonment of this process is but a question of time, for it is manifest that such enormous quantities of sludge will eventually so silt up the estuary of the Thames as to seriously interfere with commerce ; and, indeed, may prove a grave source of pollution.

The Medical News.

Established in 1843.

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